Atrazine Chlorination Transformation Products under Drinking Water Distribution System Conditions

Michael Ybarra
Research Chemical Engineer-Postdoc
Office of Research and Development
National Risk Management Research Laboratory
Water Supply Water Resource Division
Treatment Technology Evaluation Branch
(513) 569-7232
ybarra.michael@epa.gov

Authors: Michael Ybarra, Matthew Magnuson, and Karen Kleier

Key Words: chlorination, atrazine, distribution, transformation, byproducts

Chlorination is a commonly used disinfectant step in drinking water treatment. Should free chlorine be added to water used as a drinking water source, it is widely understood that many biological species in the water, along with dissolved organic and inorganic chemicals, will react with the chlorine. Reaction with biological species can result in beneficial disinfection of the water, while reaction with the chemicals can produce detrimental byproducts. If pesticides are present, whether from agricultural runoff or an accidental spill, they might undergo reactions with chlorine. The reality of potential human health effects from transformation byproducts forms the basis of the current study. This study focuses on atrazine, a widely used herbicide, but it should be remembered that it is but one of many potential chemicals of concern. Application of atrazine hovers around 76 million pounds annually, making it a significant presence in the environment (U.S. EPA-IRED, 2003). It has been reported that atrazine entering a drinking water treatment plant is essentially not transformed by chlorination. However, more recent concerns about pesticides focus not on what comes out of the plant, as required by the amended Safe Drinking Water Act, but what reaches the tap, which is driven by the Food Quality Protection Act. Residency times in distribution systems are usually monitored in days as opposed to minutes inside plants; this may allow sufficient time for atrazine to be transformed by chlorination into unknown species with unknown toxicities. Hence, there is a need to more completely study pesticide chlorination. These studies aim to address three important issues in this regard. First, the proper chemical conditions in which atrazine transforms need to be determined. Second, any potential transformation products need to be identified. Third, the mechanistic pathways for these transformation products will have to be proposed. This study will investigate chlorination of atrazine in laboratory water buffered to several pH values ranging from 5.5 to 9.5. Gas chromatography/mass spectrometry (GC/MS) and high-pressure liquid chromatography with UV and MS detection (HPLC/UV and HPLC/MS) will be used to detect any transformation products.